

DISCUS: Distributed Intelligent Swarm Control & Utilization System, Phase I

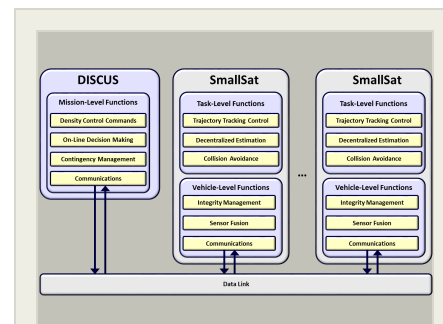
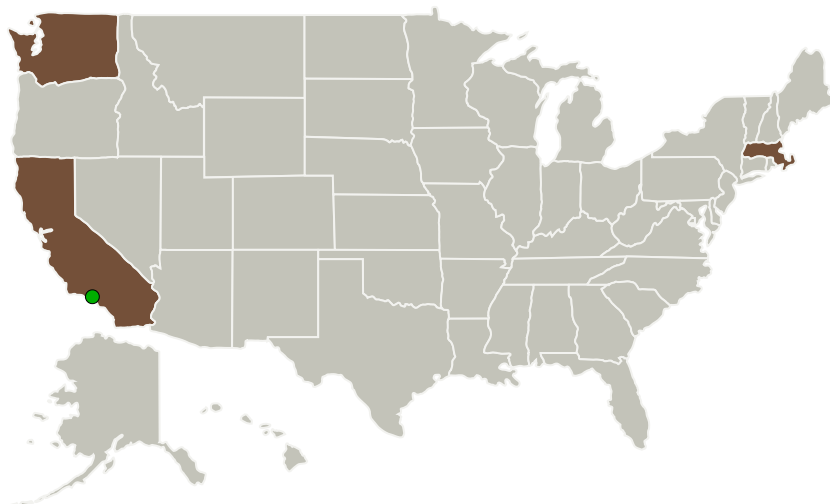
Completed Technology Project (2017 - 2018)



Project Introduction

SSCI and University of Washington (Prof. Behcet Acikmese) propose to develop, integrate and test an innovative Distributed Intelligent Swarm Control & Utilization System (DISCUS). The DISCUS will be based on advanced distributed state estimation techniques, probabilistic guidance and control under collision avoidance and other relevant mission constraints, real-time contingency management including reactive collision avoidance with unresponsive team members, and low-level fault-tolerant control robust to subsystem and component failures. Decentralized estimation is based on using RSS (Received Signal strength) and TOA (Time of Arrival) sensors, and fusion of information from EO (Electro-Optical) sensors. Guidance and Control (G&C) is based on extensions of an innovative approach to swarm density control using a Markov Chain Monte Carlo (MCMC) approach with guaranteed satisfaction of the ergodicity, motion, and safety constraints. Reactive collision avoidance will be based on extensions of a suite of SAA algorithms previously developed or under development by SSCI, while fault tolerance will be achieved by combining SSCI's approach to Fault detection, Identification and Accommodation (FDIA) with low-level baseline control. Focus on Phase I will be on the requirements and algorithm development, initial integration of a diverse suite of GNC algorithms, and feasibility demonstration on a simplified swarm simulation. Phase II will involve further maturation and full integration of DISCUS algorithms, and their demonstration under realistic conditions through hardware experiments.

Primary U.S. Work Locations and Key Partners



DISCUS: Distributed Intelligent Swarm Control & Utilization System, Phase I Briefing Chart Image

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

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Organizations Performing Work	Role	Type	Location
Scientific Systems Company, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Woburn, Massachusetts
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
University of Washington-Seattle Campus(UW)	Supporting Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH), Asian American Native American Pacific Islander (AANAPISI)	Seattle, Washington

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Scientific Systems Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

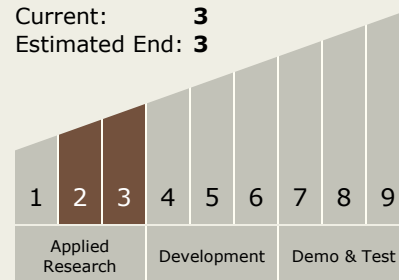
Carlos Torrez

Principal Investigator:

Jovan Boskovic

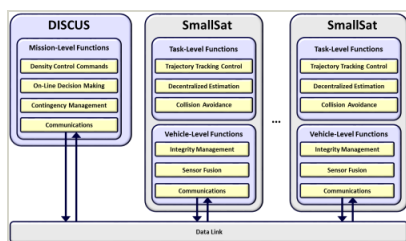
Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3



Primary U.S. Work Locations	
California	Massachusetts
Washington	

Images



Briefing Chart Image

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(<https://techport.nasa.gov/image/126508>)

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Technology Areas

Primary:

- TX10 Autonomous Systems
 - └ TX10.2 Reasoning and Acting
 - └ TX10.2.6 Fault Response

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System